

denique instrumentorum auxilio, quae ipse aut primus invenerat aut in melius mutaverat, multa accuratius investigavit, multaprius ignota patefecit, in regiones novas scientiae suae terminos feliciter propagavit. Ob imperii tanti fines tam late propagatos lauream nostram victori felici libenter decernimus.

Duco ad vos HUGONEM KRONECKER.

(8) In provincia Palatina physiologiae professor Heidelbergensis abhinc annos plus quam triginta corporis cellularum in protoplasmate disputandi materiem satis amplam invenit; abhinc annos plus quam viginti de forma "nervorum" in musculos desinentium multum conscripsit; abhinc annos decem coram Societate Regia Londinensi de ea physiologiae provincia disseruit, in qua vitae suae quasi tabernaculum posuerat. Qui totiens unumquodque duorum lustrorum spatium laboribus suis luculenter illustravit, quasi regulam vitae Horatianum illud videtur sumpsisse:—

"servetur ad imum
qualis ab incepto processerit, et sibi constet."

Ergo etiam in posterum intra decem annos speramus physiologiae et provincia chemica fore ut talium virorum victoriis laurus plurimae referantur.

Duco ad vos WILLELMUM KÜHNE.

(9) Galliae ex Collegio Parisiensi laetamur adesse hodie historiae naturalis professorem illustrem, qui, apparatu exquisito adhibito, physiologiae quaestiones physicarum rationum ope totiens explicavit. Idem non modo cordis palpitacionem alternam, sanguinis cursum continuum, musculorum denique contractionem penitus exploravit, sed etiam animalium complurium motus varios lucis ipsius auxilio feliciter illustravit. Talium virorum dignitatem contemplata, Universitas nostra non sine superbia quadam etiam in hunc virum quadrare confitebitur verba illa comoediae Gallicae celeberrimae in extremo posita:—"dignus, dignus est intrare in nostro docto corpore."

Novem virorum insignium seriem, non Senatus tantum nostri praeconio dignatam, sed etiam collegarum suorum omnium plausu comprobata, claudit hodie professor illustris, STEPHANUS IULIUS MAREY.

Prof. Kowalevsky, the distinguished Professor of Zoology in the Imperial University of St. Petersburg, was unfortunately prevented from being present to receive the honorary degree of Doctor in Science, which it had been proposed to confer on him. In introducing the nine recipients of honorary degrees who were present, the Public Orator adopted the reformed pronunciation of Latin; and his speeches were accordingly readily understood and appreciated by the great concourse of international visitors in the Senate House.

EXPERIMENTS WITH THE TELEPHONE.¹

EARLY estimates of the minimum current of suitable frequency audible in the telephone having led to results difficult of reconciliation with the theory of the instrument, experiments were undertaken to clear up the question. The currents were induced in a coil of known construction, either by a revolving magnet of known magnetic moment, or by a magnetised tuning-fork vibrating through a measured arc. The connection with the telephone was completed through a resistance which was gradually increased until the residual current was but just easily audible. For a frequency of 512 the current was found to be 7×10^{-8} ampères; (the details are given in *Phil. Mag.*, vol. xxxviii. p. 285, 1894). This is a much less degree of sensitiveness than was claimed by the earlier observers, but it is more in harmony with what might be expected upon theoretical grounds.

In order to illustrate before an audience these and other experiments requiring the use of a telephone, a combination of that instrument with a sensitive flame was introduced. The gas, at a pressure less than that of the ordinary supply, issues from a pin-hole burner (the diameter of the pin-hole may be 0.03") into a cavity from which air is excluded (see Fig. 1). Above the cavity and immediately over the burner, is mounted a brass tube, somewhat contracted at the top where ignition first occurs (*Camb. Proc.*, vol. iv. p. 17, 1880). In this arrangement the flame is in strictness only an indicator, the really sensitive organ being the jet of gas moving within the cavity and surrounded by a similar atmosphere. When the pressure is not too high, and the jet is protected from sound, the flame is rather tall and burns

bluish. Under the influence of sound of suitable pitch the jet is dispersed. At first the flame falls, becoming for a moment almost invisible; afterwards it assumes a more smoky and luminous appearance, easily distinguishable from the unexcited flame.

When the sounds to be observed come through the air, they find access by a diaphragm of tissue paper with which the cavity is faced. This serves to admit vibration while sufficiently excluding air. To get the best results the gas pressure must be steady, and be carefully adjusted to the maximum (about 1 inch) at which the flame remains undisturbed. A hiss from the mouth then brings about the transformation, while a clap of the hands or the sudden crackling of a piece of paper often causes extinction, especially soon after the flame has been lighted.

When the vibrations to be indicated are electrical, the telephone takes the place of the disc of tissue-paper, and it is advantageous to lead a short tube from the aperture of the telephone into closer proximity with the burner. The earlier trials of the combination were comparative failures, from a cause that could not at first be traced. As applied, for instance, to a Hughes' induction balance, the apparatus failed to indicate with certainty the introduction of a *shilling* into one of the cups, and the performance, such as it was, seemed to deteriorate after a few minutes' experimenting. At this stage an observation was made which ultimately afforded a clue to the anomalous behaviour. It was found that the telephone became dewed. At first it seemed incredible that this could come from the water of combustion, seeing that the lowest part of the flame was many inches higher. But desiccation of the gas on its way to the nozzle was no remedy, and it was soon afterwards observed that no dewing ensued if the flame were all the while under excitation, either from excess of pressure or from the action of sound. The dewing was thus connected with the *unexcited* condition. Eventually it appeared that the flame in

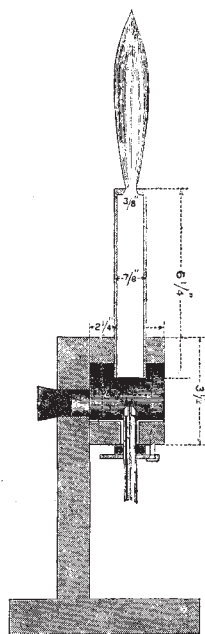


FIG. 1.

this condition, though apparently filling up the aperture from which it issues, was nevertheless surrounded by a descending current of air carrying with it a part of the moisture of combustion. The deposition of dew upon the nozzle was thus presumably the source of the trouble, and a remedy was found in keeping the nozzle warm by means of a stout copper wire (not shown) conducting heat downwards from the hot tube above.

The existence of the downward current could be made evident to private observation in various ways, perhaps most easily by projecting little scraps of tinder into the flame, whereupon bright sparks were seen to pass rapidly downwards. In this form the experiment could not be shown to an audience, but the matter was illustrated with the aid of a very delicate ether manometer devised by Prof. Dewar. This was connected with the upper part of the brass tube by means of a small lateral perforation just below the root of the flame. The influence of sound and consequent passage of the flame from the unexcited to the excited condition was readily shown by the manometer, the pressure indicated being less in the former state of things.

The downward current is evidently closely associated with the change of appearance presented by the flame. In the excited state the gas issues at the large aperture above as from a reservoir at very low pressure. The unexcited flame rises higher, and must issue at a greater speed, carrying with it not only the material supplied from the nozzle, and constituting the original jet, but also some of the gaseous atmosphere in the cavity surrounding it. The downward draught thus appears necessary in order to equalise the total issue from the upper aperture in the two cases.

Although the flame falls behind the ear in delicacy, the combination is sufficiently sensitive to allow of the exhibition of a great variety of interesting experiments. In the lecture the introduction of a threepenny-piece into one of the cups of a

¹ A discourse delivered at the Royal Institution, on June 10, by the Right Hon. Lord Rayleigh, F.R.S.

Hughes' induction balance was made evident, the source of current being three Leclanché cells, and the interrupter being of the scraping contact type actuated by clockwork.

Among other experiments was shown one to prove that in certain cases the parts into which a rapidly alternating electric current is divided may be greater than the whole (see *Phil. Mag.*, vol. xxii. p. 496, 1886). The divided circuit was formed from the three wires with which, side by side, a large flat coil is wound. One branch is formed by two of these wires connected in series, the other (in parallel with the first), by the third wire. Steady currents would traverse all three wires in the same direction. But the rapidly periodic currents from the interrupter distribute themselves so as to make the self-induction, and consequently the magnetic field, a minimum; and this is effected by the assumption of opposite values in the two branches, the ratio of currents being as 2 : -1. On the same scale the total or main current is +1. It was shown by means of the telephone and flame that the current in one branch was about the same (arithmetically) as in the main, and that the current in the other branch was much greater.

THE STOCKHOLM MEETING OF THE IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute, held at Stockholm on August 26 and 27, under the presidency of Mr. E. P. Martin, of Dowlais, was a most successful one. An influential reception committee, including the Governor General of Stockholm and all the leading men in the iron industry, entertained the members with lavish hospitality. The King of Sweden invited the members to supper at his Palace, and attended the meeting in person.

The meetings were held at the House of Lords, a fine building erected in 1648, and were largely attended. Addresses of welcome were given, and the President announced that Prof. W. C. Roberts-Austen, C.B., F.R.S., had been unanimously chosen to succeed him as President.

No less than eleven papers were on the programme. The first paper read was by Mr. R. Åkerman, Director General of the Board of Trade, on the development of the Swedish iron industry. He traced the history of the industry from the earliest times, and showed the influence exerted by the chemists Scheele and Berzelius on metallurgy. The Swedish production last year comprised 538,197 tons of pig iron, 189,632 tons of wrought iron, 107,679 tons of Bessemer ingots, and 165,836 tons of open-hearth ingots.

Prof. G. Nordenström read a paper describing the characteristic features of Swedish iron ore mining. He began with an account of the geology of the country, and then discussed the geographical distribution of the iron ores, their mode of occurrence, composition, mining and production. The total production last year was 2,086,119 tons. Much of the paper was devoted to the use of magnetic instruments in exploring for iron ore, a subject previously treated by Mr. B. H. Brough in a paper read before the Institute in 1887.

Mr. C. P. Sandberg's paper on the danger of using too hard rails, contained the results of experience on the Swedish railways. He considered that it is preferable to adopt a heavier weight of rail of moderate hardness, rather than to try to remedy the deficiency in weight of rails originally used by now resorting to a dangerous hardness of rail of the same section.

Mr. A. Greiner, director of Cockerill's works at Seraing, communicated, as a supplement to the paper he read in May, the results of experiments by Mr. A. Witz with a simplex motor, using blast furnace gas. The results were highly satisfactory, showing that the working of the 200 horse-power engine is very economical and as regular as that of a steam engine. The dust in the gas is in no way injurious to its continuous operation.

Mr. H. Lundbohm, of the Geological Survey of Sweden, described the iron ore deposits of Kiirunavaara and Luossavaara, the largest deposits in Swedish Lapland. The ore occurs in bed-like masses in porphyry. It is very rich, and the author estimates that there is above the level of the lake at Kiirunavaara 215,000,000 tons, and at Luossavaara 18,000,000. The situation of the beds within the Arctic circle at 67° 50' north lat. renders them inaccessible. A railway, now in course of construction, from the Gulf of Bothnia to Ofoten, will give access to these deposits and furnish a most important source of iron ore supply.

Mr. J. E. Stead supplemented the important paper on the

crystalline structure of iron by presenting further facts bearing upon the brittleness produced in soft steel by annealing. The most important point established is that phosphorus must not exceed 0.08 per cent.

The paper on the micro-chemistry of cementation, read by Prof. J. O. Arnold, was of special interest as giving a detailed description of the effect of cementation on the brands of iron sent by Sweden to England.

Mr. G. R. Johnson, of Embreville, Tennessee, contributed a paper on the action of metalloids on cast iron. He insisted that foundrymen in buying iron should require analysis as well as fracture, for it is impossible to judge of the composition of an iron merely by looking at it.

Prof. W. C. Roberts-Austen discussed the action of the projectile and of the explosives on the tubes of steel guns, showing the interesting results obtained by an examination of the bores of corroded guns by the aid of micro-photography. An interesting discussion followed the reading of the paper, a noteworthy contribution being supplied by Mr. Nordenfeldt.

The two other papers on the list were taken as read. Baron H. Jüptner applied the data as to the thermal relations of iron carbon alloys contained in Prof. Roberts-Austen's fourth Report to the Alloys Research Committee of the Institution of Mechanical Engineers, to correcting the conclusions expressed in his paper on the solution theory of iron and steel read last May. And Prof. E. D. Campbell, of the University of Michigan, described some further experiments made by him on the diffusion of sulphides through steel.

The usual votes of thanks were given, and the meeting terminated.

An elaborate programme of excursions was arranged. Various works in Stockholm were visited. Before the meeting a limited number of members visited the remarkable iron mines of the Arctic Circle, and after the meeting there were two excursions occupying several days: one to the ironworks of Domnarfvel, Hofors, Sandviken, and the mines of Grängesberg, Falun, and Dannemora; and the other to the ironworks of Laxå, Degerfors, Bofors, Uddeholm and Storfors, and to the Persberg iron mine. All the arrangements were most satisfactory, and great credit is due to the Hon. Secretary of the Reception Committee, Mr. J. C. Kjellberg, and to Mr. Brough, the Secretary of the Institute.

THE OLD BEDS OF THE AMU-DARIA.

THE Russian Geographical Society has just issued a new volume which contains an important contribution to the much debated question as to the old beds of the Amu-daria. It is written by the mining engineer, A. M. Konshin, and contains a geological map showing the extension of the Pliocene and modern Caspian deposits, as well as of the Loess and the fluvial deposits in the Transcaspian region, and a number of drawings of dunes and *barkhans* (of aeolic origin), and small plans of the Uzboi and the Ungus (supposed old beds of the Amu).¹

When the Transcaspian region was first opened to scientific exploration it was generally believed that the ravine which runs from Lake Aral to the Caspian Sea, the Uzboi, as well as the Ungus and the Kelif Uzboi, represent old beds of the Amu, which, continually shifting its bed towards the right, ran successively at the foot of the Kopet dagh, then across the Karakum desert, and finally, after having taken to its present bed, sent a branch towards the Caspian Sea along what is now known as the Uzboi. This hypothesis has still a fervent adherent in Baron Kaulbars. A further exploration of this region, which was made in 1883, proved, however, that the Uzboi has not the characters of an old river bed, and that in Post-Pliocene times the Caspian Sea sent a broad gulf eastwards, into what is now the Karakum desert. The Ungus, which crosses this desert, is also not an old bed but an escarpment by which the Pliocene clays of the Karakum Plateau fall towards the lower-lying Post-Pliocene Karakum Sands. Consequently, two hypotheses are now in presence. One of them, supported by M. Konshin, is that a gulf of the Caspian stretched as far eastwards as the longitude of Merv, sending in its western part a branch northwards, along the Uzboi, as far as the

¹ "Contribution to the Question relative to the Old Course of the Amu-daria." 256 pp. with several maps and drawings. St. Petersburg, 1897. (*Memoirs of the Russian Geographical Society*, General Geography, vol. xxiii. part 1). Russian.